

# BENDIX POWER BRAKE SERVICE MANUAL

## BENDIX TREADLE-VAC POWER BRAKE UNIT

### DESCRIPTION

#### (DISC REACTION TYPE)

The Disc Reaction Treadle-Vac introduced on 1959 model cars is quite similar to previous designs of Treadle-Vacs except the method for producing the reactionary feel during its operation. The design incorporates a rubber reaction disc which is located in the vacuum power piston between the end of the valve plunger and the hydraulic plunger rod. During operation these parts are in contact with each other and thereby produce a reactionary condition which provides the "brake feel" to the driver. The Disc Reaction Treadle-Vac consists of three basic components combined into a single unit, see Figures 1 and 2. These are:

1. A vacuum power cylinder which consists of a cylinder, a vacuum power piston, and piston return spring.
2. A mechanically actuated control valve which controls the degree of brake application or release in accordance with the pressure applied to the brake pedal or treadle. The control valve consists of a poppet valve, an atmospheric port and a vacuum port. The atmospheric port seat is located on the valve plunger while the vacuum port seat is located on the rear piston plate.
3. A hydraulic cylinder which contains a hydraulic plunger, a compensating valve, a residual check valve, and a fluid reservoir.

The components that make up the valve assembly are contained within the vacuum power piston and are connected to the brake pedal or treadle through the valve operating rod, a lever and a push rod. The valve plunger is attached to the valve operating rod and moves within the vacuum power piston. A valve return spring is used to return the valve plunger and valve operating rod to the released position when the brakes are released.

The valve poppet is assembled in a flexible diaphragm within the power piston. When the power unit is in the released position, the poppet return spring overcomes the forces on the poppet as a result of atmos-

pheric pressure on the left side and vacuum on the right side of the poppet to hold the poppet on the vacuum seat. A boot type of seal is used to seal the opening between the piston plate and the valve operating rod.

When a force is applied to the power piston, the hydraulic plunger transforms this force into hydraulic pressure within the hydraulic cylinder. The reaction disc located in the power piston between the hydraulic plunger and the valve plunger transmits a "reaction force" to the left against the valve plunger, valve rod and linkage to the driver's foot in proportion to the hydraulic pressure developed within the hydraulic cylinder. The combined hydraulic cylinder and fluid reservoir are securely attached to the vacuum power cylinder. A Vellumoid gasket and a rubber ring gasket seal the end of the vacuum cylinder while a wiper leather seal and a rubber cup type seal is used to seal the hydraulic plunger against leakage. The fluid reservoir is sealed off from the hydraulic cylinder by the compensating valve which is closed at all times except when the Treadle-Vac is in its fully released position. A residual check valve near the output end of the hydraulic cylinder maintains a slight pressure in the hydraulic brake lines and wheel cylinders during release of the brakes to prevent the entrance of air into the hydraulic brake system during release of the brakes.

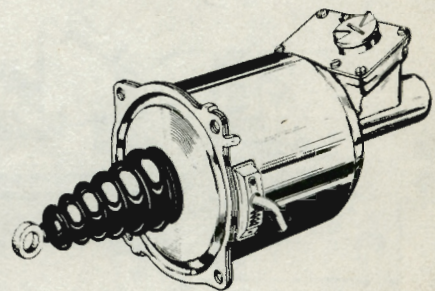


Fig. 1. External View.

#### IDENTIFICATION TABLE

- |                              |                     |
|------------------------------|---------------------|
| 1—Valve Operating Rod        | 14—Pedal Push Rod   |
| 2—Valve Rod Seal & Bumper    | 15—Vacuum Port      |
| 3—Valve Plunger              | 16—Atmospheric Port |
| 4—Poppet Diaphragm           | 17—Poppet Valve     |
| 5—Power Piston               | 18—Vacuum Hose      |
| 6—Reaction Disc              | 19—Power Lever      |
| 7—Piston Return Spring       | 20—Air Cleaner      |
| 8—Vacuum Cylinder            | 21—Vacuum Tube      |
| 9—Filler Cap                 |                     |
| 10—Hydraulic Fluid Reservoir |                     |
| 11—Compensating Valve        |                     |
| 12—Residual Check Valve      |                     |
| 13—Outlet Fitting            |                     |

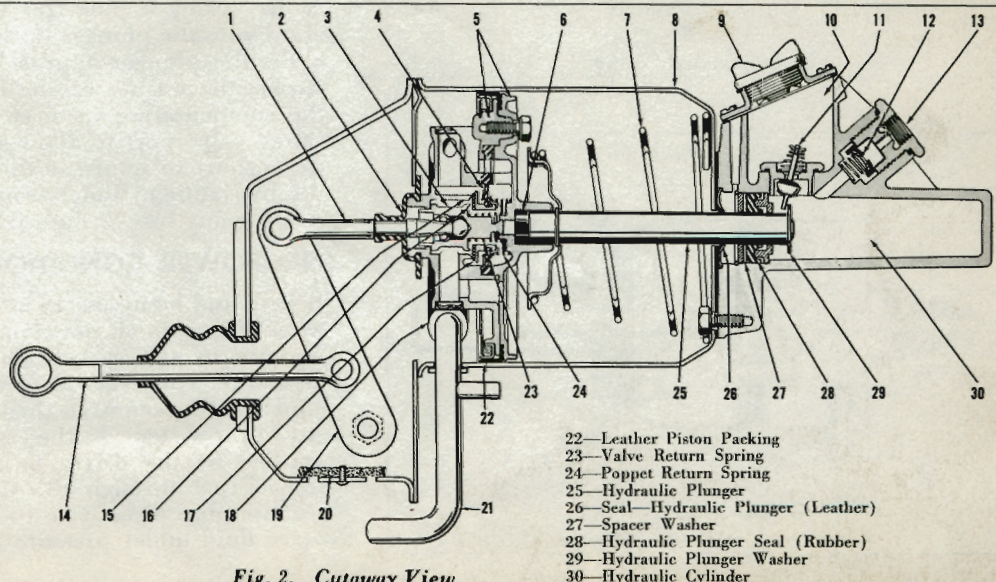


Fig. 2. Cutaway View.

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| 22—Leather Piston Packing           | 28—Hydraulic Plunger Seal (Rubber) |
| 23—Valve Return Spring              | 29—Hydraulic Plunger Washer        |
| 24—Poppet Return Spring             | 30—Hydraulic Cylinder              |
| 25—Hydraulic Plunger                |                                    |
| 26—Seal—Hydraulic Plunger (Leather) |                                    |
| 27—Spacer Washer                    |                                    |



## PRINCIPLES OF OPERATION

### RELEASED POSITION (Fig. 3)

With the engine running and the brakes released, vacuum from the engine intake manifold is transmitted to the Treadle-Vac through the vacuum tubing, check valve and reservoir. In the released position (no pressure applied to the brake treadle), the valve operating rod and plunger are held to the left in the power piston by the valve return spring to close the vacuum port and open the atmospheric port. With atmosphere present on both sides of the piston, the unit is in the released position. The piston return spring attached to the hydraulic plunger holds both the vacuum power piston and hydraulic plunger in the released position. With the hydraulic plunger in

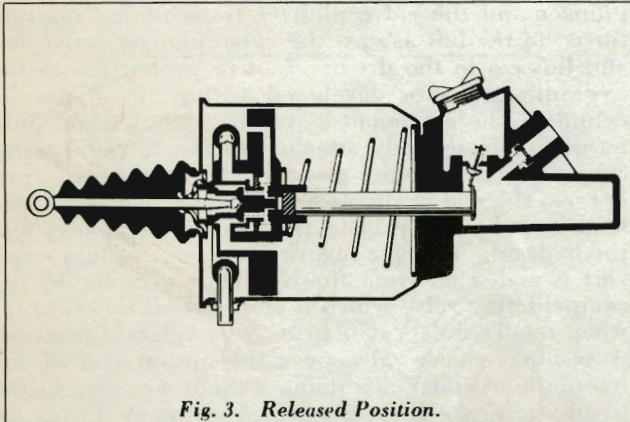


Fig. 3. Released Position.

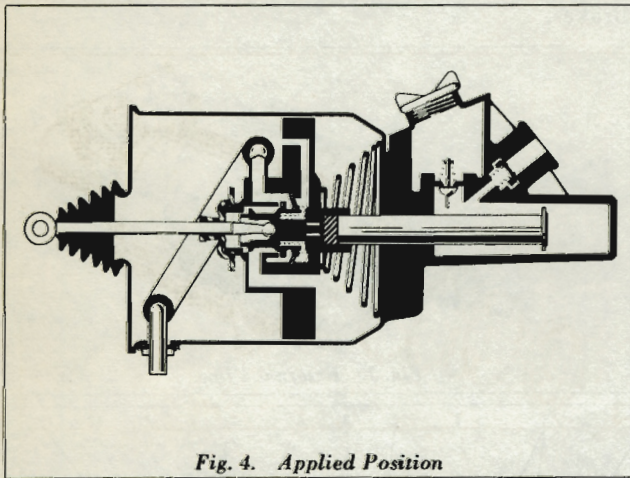


Fig. 4. Applied Position

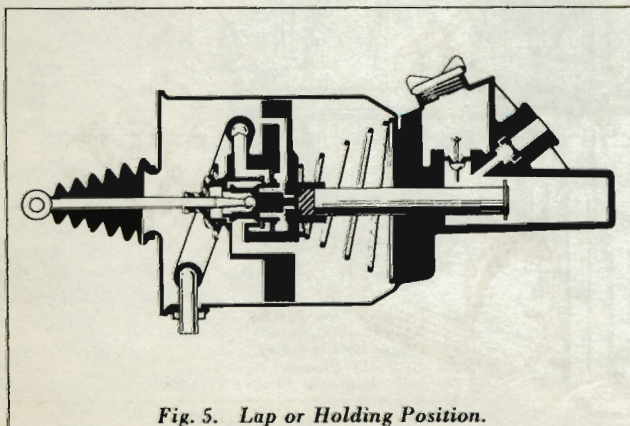


Fig. 5. Lap or Holding Position.

the released position the compensating valve is tilted by the washer near the end of the hydraulic plunger to open the passage between the fluid reservoir and the hydraulic cylinder.

### APPLYING POSITION (Fig. 4)

As the brakes are applied by the driver, the valve operating rod moves the valve plunger to the right to close the atmospheric port. Further movement of the valve plunger opens the vacuum port. With the vacuum poppet open, the right side of the vacuum piston is also open to vacuum through the passages in the piston. With a partial vacuum on the right side of the piston and atmospheric on the left side of the piston, the differential in pressure creates a force to move the vacuum piston and hydraulic plunger to the right. The initial movement of the hydraulic plunger allows the compensating valve to seat and close off the passage between the fluid reservoir and hydraulic cylinder. As pressure is developed within the hydraulic cylinder, fluid is forced through the residual check valve and brake lines to the wheel cylinders. This same pressure acting against the end of the hydraulic plunger transmits a portion of the force back through the plunger and reaction disc against the valve plunger which tends to close the vacuum port and bring the power piston to rest. Since the reaction force is proportional to the hydraulic pressure developed within the hydraulic cylinder and wheel cylinders, a "feel" of the amount of braking is transmitted to the driver.

### HOLDING POSITION (Fig. 5)

When pressure applied by the driver is held constant, the valve returns to the "lap" or holding position. In the "lap" or holding position both the vacuum and atmospheric ports of the poppet valve are closed to hold the application. No movement of the power piston will occur unless the force against the brake pedal is either increased or decreased.

### RELEASING

When the driver releases the force applied to the brake pedal, the valve operating rod and valve plunger return to the released position with the vacuum port closed and the atmospheric port opened to admit atmosphere to the right side of the power piston and balance the piston in atmosphere. The power piston return spring is then free to return the power piston and hydraulic plunger to the released position. As the hydraulic plunger approaches the released end of its stroke, the washer on the hydraulic plunger contacts the compensating valve stem to reopen the compensating valve port to allow any excess fluid (due to expansion) to return to the reservoir or fluid to enter the hydraulic cylinder from the reservoir to compensate for any loss of fluid from the brake system.

### NO POWER CONDITION

If it should be necessary at any time to use the brakes when the engine is not running and there is no reserve vacuum in the system, the brakes can be applied manually. However, in such an event more physical effort will be required than when the vacuum is present in the system. In the case of "no power" the force applied by the driver to the brake treadle will be transmitted through the linkage, valve plunger and reaction disc directly to the hydraulic plunger to displace fluid under pressure to the wheel cylinders.



The following service instructions cover the disassembly and assembly of the Treadle-Vac step by step. Use extreme care in the handling of hydraulic system parts to prevent their coming in contact with mineral oil or grease. **DO NOT HANDLE HYDRAULIC PISTON CUPS OR SEALS WITH GREASY HANDS.**

When overhauling the Treadle-Vac, always use a Repair Kit.

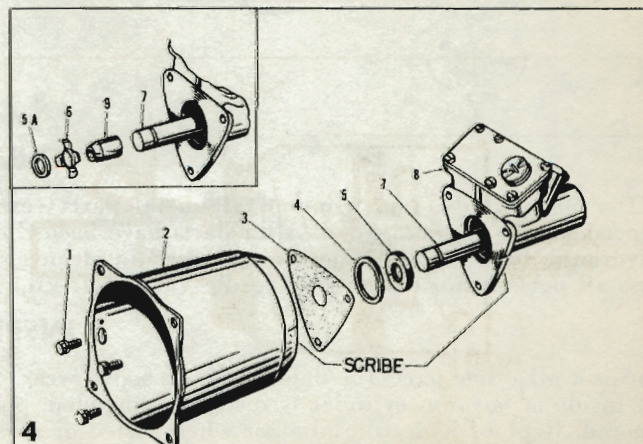
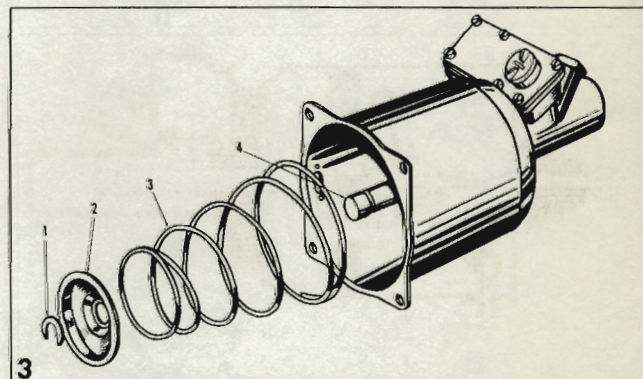
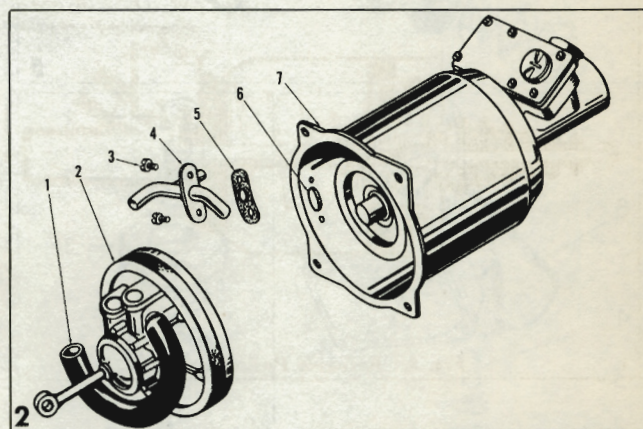
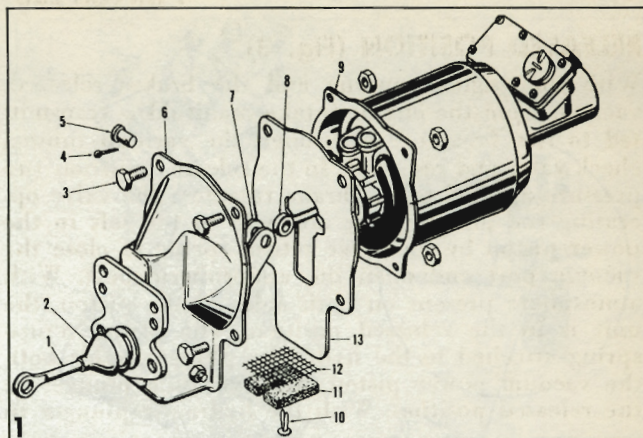
## DISASSEMBLY

**1** Scribe across end plate (6) and vacuum cylinder (9). Remove four end plate attaching cap screws (3) (if used) or bend out two tabs on end plate (if tabs are used to hold end plate to cylinder). Remove rubber dust guard from valve operating (when used) and remove end plate. If Treadle-Vac includes pedal linkage, remove cotter pin (4) and clevis pin (5) from end of Treadle-Vac valve operating rod (8), before removing end plate with linkage. Remove shell end plate (13) (if used).

**2** Disconnect vacuum hose (1) from vacuum tube and plate (4), attaching screw or screws (3), tube and plate, and air cleaner filter (when part of vacuum tube assembly). Remove burrs from inside of vacuum cylinder at screw holes and remove vacuum piston assembly (2) from vacuum cylinder.

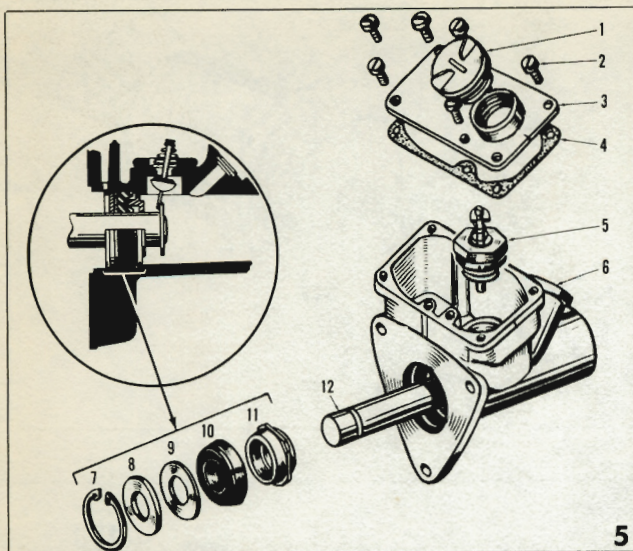
**3** Push in on spring retainer plate (2) sufficient to release "C" washer (1). While holding spring compressed, slide "C" washer out of groove in hydraulic plunger (4). Remove retainer plate (2) and vacuum piston return spring (3).

**4** Scribe across vacuum cylinder (2) and hydraulic cylinder (8). Hold hydraulic cylinder in vise and remove three vacuum cylinder attaching screw and lock-washer assemblies (1) (use 7/16" socket with extension). Lift off vacuum cylinder, remove Vellumoid gasket (3) and rubber ring gasket (4) (if used). Push hydraulic plunger (7) into hydraulic cylinder and remove leather seal (5) or seal (5a) and seal retainer (6) (when used) from flange recess.

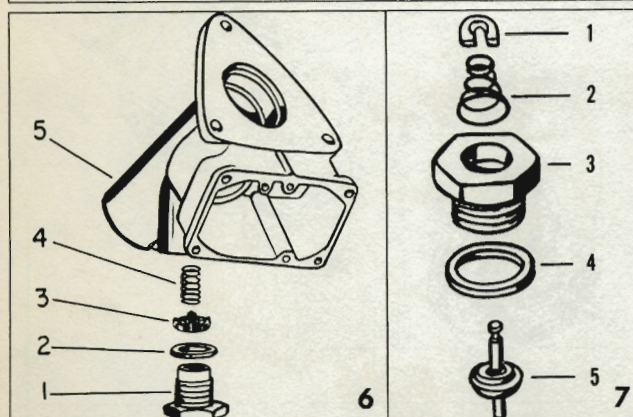




## DISASSEMBLY

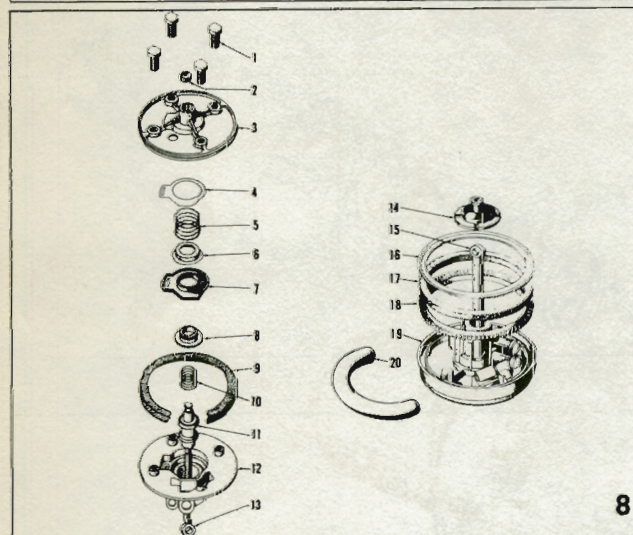


**5** Scribe across hydraulic cylinder and cover (3). Remove filler cap (1) and dip stick (if used), then remove six cover attaching screws (2), cover (3) and gasket (4). Remove compensating valve (5) (use  $1\frac{1}{8}$ " thin wall socket). Loosen outlet fitting (6) with  $1\frac{1}{4}$ " wrench. **DO NOT REMOVE OUTLET FITTING AT THIS TIME.** Remove retainer ring (7) (use Truarc Pliers, Tool No. 73631). Pull hydraulic plunger (12) out of hydraulic cylinder and remove steel washer (8), fiber guide washer (9), rubber cup (10) and cup retainer (11) from hydraulic plunger.



**6** Remove hydraulic cylinder from vise and then remove outlet fitting (1), residual check valve spring (4), valve cup and disc retainer (3) from hydraulic cylinder (5). Remove gasket (2) from fitting (1).

**7** Clamp compensating valve fitting (3) in vise; spread and remove spring retainer (1), then remove spring (2), valve stem and poppet (5) and fitting gasket (4) from compensating valve fitting.



**8** Remove valve rod seal and bumper (14) from piston (19) and from valve operating rod (15). Remove vacuum hose (20) from tube on rear piston plate. Remove felt retainer ring (16), felt (17) and expander spring (18), from rear piston plate. Turn piston over, clamp rear piston plate (12) in vise and remove four cap screws (1), front piston plate (3), diaphragm plate (4) and return spring (5). Remove diaphragm parts group (6) thru (8) as an assembly and then separate these parts. Lift off leather piston packing (9) and valve return spring (10). Remove rubber reaction disc (2) from front piston plate (3). (If necessary, use 5/16 rod with end squared off to press out reaction disc). Remove valve plunger (11) with valve operating rod (13) from rear piston plate. **NOTE:** On those units where the diameter of the valve rod end is larger than the hole in the piston and it is necessary to remove either valve rod or valve plunger, hold assembly with valve plunger (11) down and inject alcohol in valve plunger opening around rod to wet the rubber lock. Then drive valve plunger off valve rod.

## CLEANING

After disassembly, immersion of all metal parts (except those containing rubber) in Bendix Metalcene or Speedclene is recommended. After parts have been thoroughly cleaned, those parts which come in contact with hydraulic brake fluid should be rewashed in clean alcohol before assembly. When overhauling a Treadle-Vac use all parts furnished in the Treadle-Vac repair kit.

## INSPECTION

Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts or housings. If inside of vacuum cylinder is rusted or corroded, polish with steel wool or fine emery cloth. Replace when scored. Replace hydraulic plunger when rusted or scored. For complete list of service parts, refer to service parts catalog.



## ASSEMBLY

Before assembly, dip all hydraulic system parts in clean alcohol or Bendix Assembly Fluid and place in a clean pan or on a clean paper.

**1** Insert grooved end of compensating valve poppet and stem (5) through hole in fitting (3) from threaded end. Assemble large diameter end of spring (2) over stem, hold valve poppet on seat, compress spring and assemble retainer washer (1) in groove of valve stem. Squeeze ends of washer together with pliers. Assemble new gasket (4) over threads of compensating valve fitting.

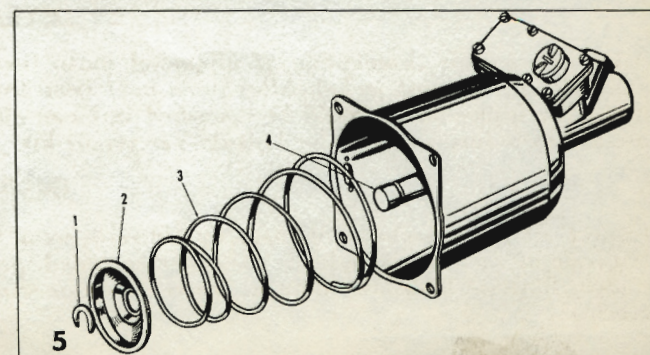
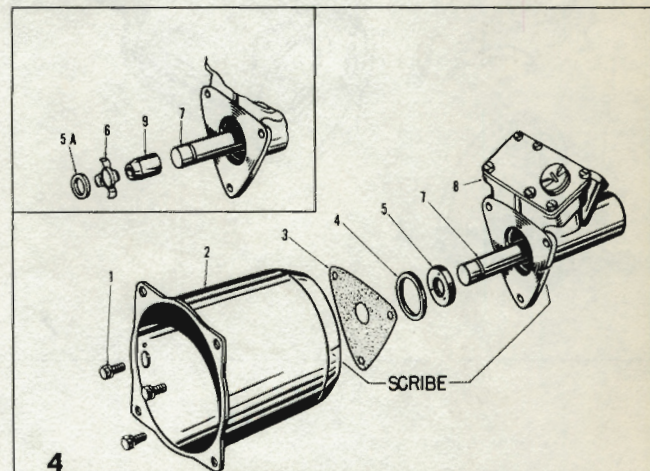
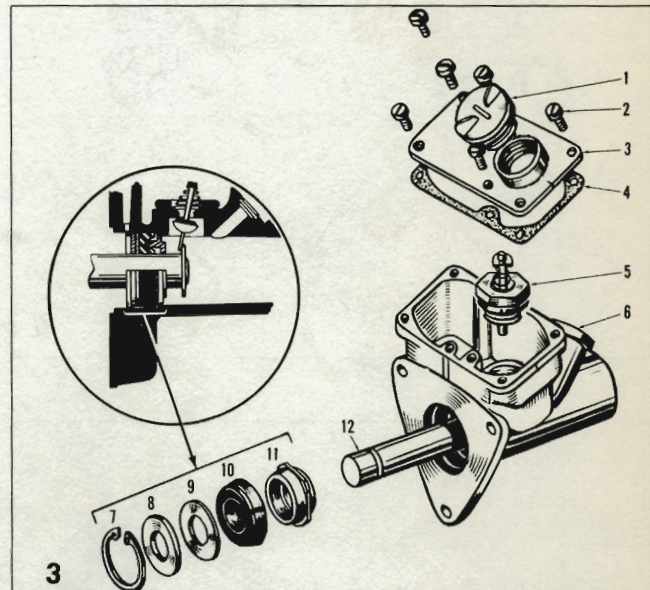
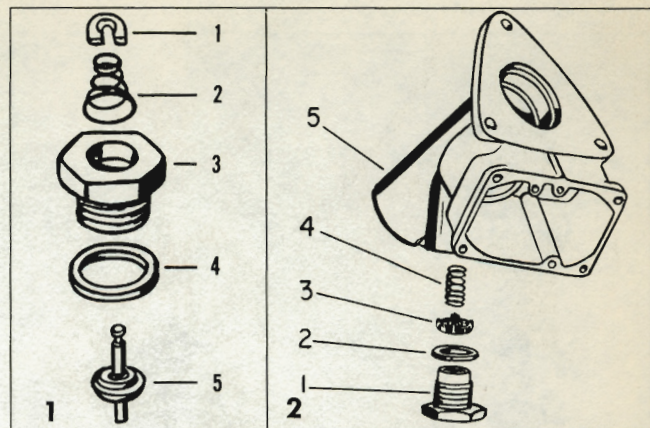
**2** Assemble new gasket (2) over threads of hydraulic fitting (1). Hold outlet fitting in vertical position and insert crowned side of cup and retainer (3) in fitting. Place check valve spring (4) in recess of retainer. Hold hydraulic cylinder upside down as shown and thread outlet fitting (1) into hydraulic cylinder hand tight.

**3** Hold hydraulic cylinder in vise. Insert washer end of hydraulic plunger (12) in cylinder and assemble seal parts over end of plunger as follows: cup retainer (11), with counter-bored side away from washer at end of plunger; cup (10) (dip cup in brake fluid before assembly); fiber guide washer (9) and steel spacer washer (8). Slide seal parts into recess of cylinder, push plunger in to end of its stroke and assemble retainer ring (7) in ring groove of cylinder (use Truarc pliers Tool 73631). Assemble compensating valve (5) in threaded hole of cylinder and securely tighten (use  $1\frac{1}{8}$ " thin wall socket). Place new cover gasket (4) on hydraulic cylinder, align cover (3) to scribe marks, replace and securely tighten cover screws (2). Assemble filler cap (1) with dip stick (if used). Securely tighten outlet fitting (6) with  $1\frac{1}{4}$ " wrench.

**4** Pull out hydraulic plunger (7), place seal assembly Tool No. 73647 (9) over end of plunger and assemble leather seal (5) over seal tool with lip of leather toward hydraulic cylinder or seal retainer (6) and leather seal (5A), see inset upper left. Press seal into recess of hydraulic cylinder and then remove seal assembly tool. Place rubber ring gasket (4) (if used) in recess of hydraulic cylinder. Insert three cap screws (1) through holes in end of vacuum cylinder (2) and holes in gasket (3). Align vacuum cylinder and hydraulic cylinder to scribe marks, assemble three cap screws and securely tighten screws. Wipe out inside of vacuum cylinder and then pull out hydraulic plunger to end of its stroke.

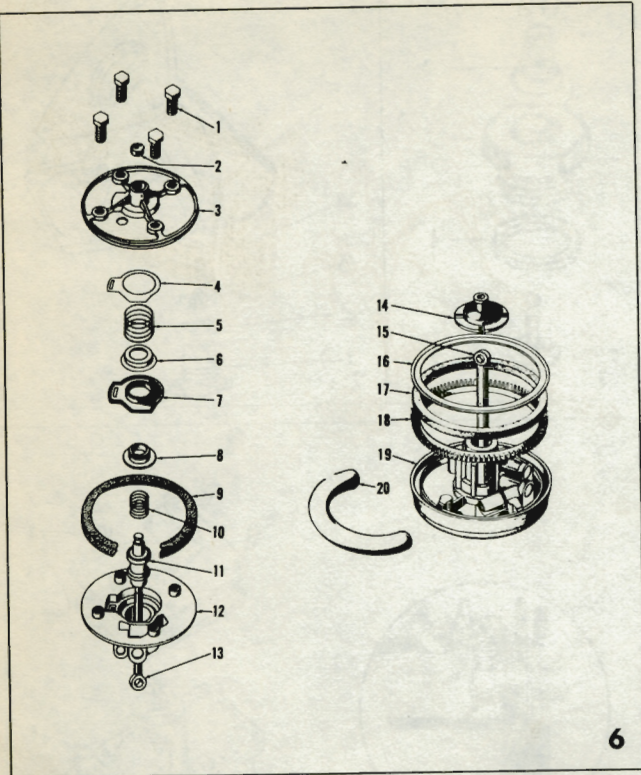
NOTE: Some units use leather seal (5A) with seal retainer (6) as shown in inset in place of rubber ring gasket (4) and combination leather seal and retainer (5) as shown in the main view.

**5** Place larger diameter end of vacuum piston return spring (3) in vacuum cylinder and assemble retainer plate (2) over end of hydraulic plunger (4) as shown. Compress spring and assemble "C" washer (1) in groove of hydraulic plunger.





## ASSEMBLY

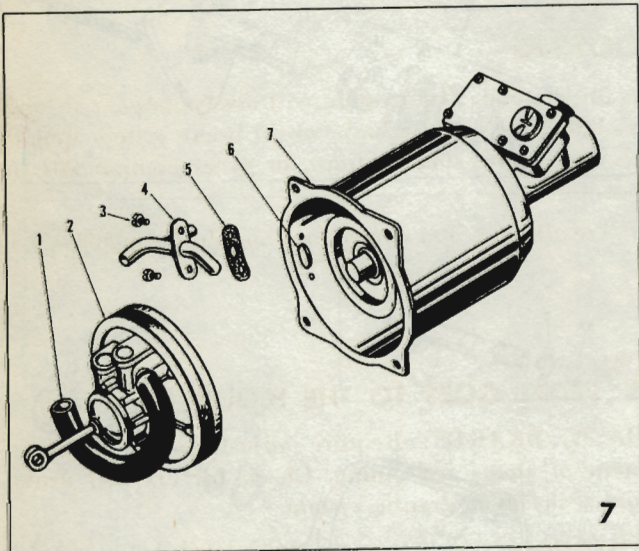


**6** If valve operating rod (13) and valve plunger (11) \* were separated, insert small diameter ball end of valve operating rod through hole in rear piston plate and assemble to valve plunger as follows: dip valve plunger in alcohol before inserting valve rod; make certain end of rod is locked in place in valve plunger. It may be necessary to tap end of valve rod to seat rod in valve plunger. Assemble spring (10) over end of plunger. Assemble leather packing (9) on piston with lip side toward valve operating rod end. Assemble diaphragm (7) over shoulder of valve poppet (8). Place this assembly in recess of piston plate and assemble spring retainer (6) and diaphragm plate (4) on diaphragm. Align by-pass. Assemble poppet return spring (5) over flange of spring retainer.

Place front piston plate (3) \* on rear piston plate making certain by-pass holes are in register and assemble four attaching cap screws (1). Leave screws loose.

Place assembly ring (Tool No. 73661) over piston leather, turn piston assembly upside down and assemble expander spring (18) against inside lip of leather packing as shown. Dip felt (17) in Bendix Vacuum Cylinder Oil and assemble against expander spring. Assemble retainer plate (16) as shown making certain plate is securely anchored in grooves at four projections of piston assembly. Securely tighten four screws. Dip valve rod seal and bumper (14) in alcohol and assemble over end of valve operating rod (15) making certain seal is seated in groove at hub of piston assembly. Assemble rubber reaction disc (2) \* in center bore of front piston plate.

\* Apply thin film of Rykon "O" grease to reaction disc (2) also to the front and rear bearing surfaces of the valve plunger and to the hydraulic plunger bore in the front piston plate (3).



**7** Apply thin film of Bendix Vacuum Cylinder Oil to inside of cylinder bore. Attach vacuum hose (1) to piston (2) as shown. Insert piston in cylinder with free end of hose in line with center of elongated hole (6). Assemble gasket or air filter element (5) (if used) on vacuum tube and cover. Insert short end of vacuum tube through vacuum cylinder and attach air cleaner and vacuum tube assembly (4) to cylinder with screw or screws (3). Slide hose on tube approximately  $\frac{5}{8}$ ". Operate piston through its full stroke several times to make certain hose does not rub against cylinder or piston. Reposition hose on tube when necessary.

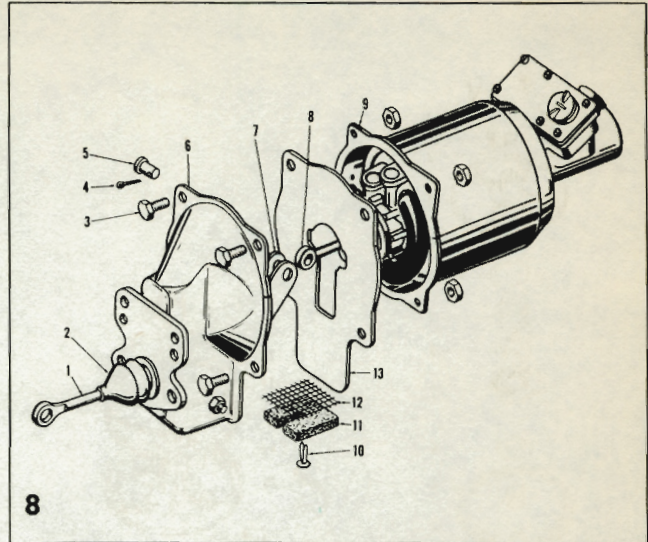


## ASSEMBLY

**8** Place air cleaner element (11) and screen (12) in position on inside of end plate and bracket (if used), insert fastener (10) through air cleaner and screen and spread ends of fastener. If unit includes pedal linkage, place shell end (13) over end of valve rod (8), push in on pedal push-rod (1) and attach lever (7) to valve operating rod (8) with clevis pin (5) and cotter pin (4). Align end plate bracket (6), shell and plate (13) and vacuum cylinder to scribe marks and attach end plate bracket to vacuum cylinder (9) with four attaching screws (3). Securely tighten screws.

On units without end plate bracket and lever assembly, align holes in end plate and gasket with holes in flange of cylinder and bend two opposite tabs over flange of cylinder or attach end plate to cylinder with bolts if bolts are included. Dip small diameter end of rubber dust guard (2) in alcohol and assemble guard over end of pedal rod (1) if unit includes pedal linkage or over valve operating rod. Attach lip of guard to end plate bracket or to scallops at center of end plate.

**ASSEMBLY IS NOW COMPLETED.**



## TROUBLE SHOOTING

Brake troubles may be easily diagnosed if the complaint is understood. The trouble will always appear in one or more of the four common complaints covered below. Related parts of the basic wheel brake system should be checked and corrections made in adjustments, lubrication and lining specifications, or other components in accordance with the vehicle manufacturer's recommendations.

The following briefly cover the conditions that apply to cordance with procedures covered in this manual.

the Treadle-Vac and corrections should be made in ac-

### 1 HARD PEDAL

**BASIC BRAKES:** The pedal mechanism should be thoroughly checked for free movement of all parts and lubricated per vehicle manufacturer's specification. Glazed linings or linings saturated with fluid should be replaced.

**TREADLE-VAC:** Check for vacuum leaks in system, collapsed or restricted vacuum hose or line, and also for low manifold vacuum. Possible restricted air cleaner or internal vacuum leak.

### 2 "GRABBY" BRAKES

**BASIC BRAKES:** Can be caused by grease or brake fluid on lining, brake shoe anchor pins positioned incorrectly or scored drums.

**TREADLE-VAC:** Possibly in control valve portion of piston or at reaction rod.

### 3 PEDAL GOES TO THE FLOOR

**BASIC BRAKES:** Require adjustment or replacement of shoes and lining. Check for cracked drum and leaks in hydraulic system.

**TREADLE-VAC.** Reservoir fluid level low — air in hydraulic system of Treadle-Vac, in brake lines, or in brake wheel cylinders. Internal hydraulic leak at plunger cup, or at compensating valve.

### 4 BRAKES FAIL TO RELEASE

**BASIC BRAKES:** Pedal mechanism not operating freely — brakes improperly adjusted — anchor pins bound up.

**TREADLE-VAC:** Possibly at fluid compensating port, in the valve portion of the piston, excessive friction between the piston and the vacuum cylinder, or incorrect adjustment of hydraulic push rod.